

(C) Remarks

Amendments to the Claims:

The paragraph numbering shown below correspond to the paragraph numbering in the Office Action

Claim objections because of informalities

4. Claim 12 has been amended to correct the informality noted in the Office Action.

Rejections under 35 USC § 112

6. Claims 10, 13 and 21 have been amended to correct the indefiniteness noted in the Office Action.

Rejections under 35 USC § 101

8. Claims 1, 15, 18, 21 and 24 have been amended in view of the rejection under 35 USC § 101. Because the element of claim 25 was substantially incorporated into the amended claim 24, claim 25 has been cancelled.

Double patenting issue

9. A Terminal Disclaimer is submitted herewith to overcome the provisional rejection based on a nonstatutory double patenting.

Rejections under 35 USC 103

A Declaration under 35 USC § 132 by Dr David Monk is submitted herewith in support of the technical discussion of the cited references and the present application.

- 11-1 With reference to claim 1, it is stated in the Office Action that:

“Regarding claims 1 and 13-14, Partyka et al. disclose a method of processing a group of spatially related seismic data traces (abstract, and summary, column 5, line 9, through column 11, line 7) comprising:

defining seismic data windows extending over selected portions of said group of spatially related seismic data traces (transform window, column 17, lines 36-57);

generating a frequency spectrum of the seismic data within successively selected windows of said seismic data traces by applying a transform to said

successively selected windows (discrete Fourier transform, column 7, lines 10-13);

determining the frequency having the greatest amplitude within the frequency spectrum of the seismic data within said successively selected windows (location of maximum frequency, column 31, lines 54-57; and Fig. 14);

utilizing said determined frequencies having the greatest amplitude to generate a seismic display in which horizontal dimension represents distance and vertical dimension represent time (to image and map the extent of thin beds, column 7, lines 10-13; a commercially available visualization software package, Applicant's assertion, lines 1-2, page 15, tuning cube, column 20, lines 13-17); and

utilizing said seismic display to determine the presence of thin beds (thin bed effects may be identified, column 24, lines 24-32)

Partyka et al. fail to expressly disclose the transform having poles on the unit z-circle, where z is the z-transform. Nevertheless, Partyka et al. suggest that a wide variety of discrete data transformations other than the Fourier (column 38, lines 13-24) can be used to identify thin bed effects.

Cox et al. disclose "maximum entropy power spectral analysis eliminates the resolution constraints imposed by convolution of window's Fourier transform with the spectrum of the trace segments" (Cox, page 2225, column 2, paragraph 3). In other words, using maximum entropy method will enhance the resolution of a moving window analyzer. Specifically, Cox et al. disclose the missing element that the transform having poles on the unit z-circle, where z is the z-transform.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Partyka et al. to incorporate the teachings of Cox et al. to obtain the invention as specified in claims 1 and 13-14 because by using maximum entropy method to replace Fourier transform the resolution of a moving window analysis will be enhanced (Cox, abstract).

Applicant agrees that Partyka et al. do show the first element of claim 1 and a portion of the second element of claim 1 of US Patent Application 09/498,012, as follows:

defining seismic data windows extending over selected portions of said group of spatially related seismic data traces;

generating a frequency spectrum of the seismic data within successively selected windows of said seismic data traces by applying a transform to said successively selected windows ;

Applicant further agrees that Partyka et al. shows the third element of claim 1:

determining the frequency having the greatest amplitude within the frequency spectrum of the seismic data within said successively selected windows;

However, the Examiner has combined the first two elements and the third element in a manner neither taught nor suggested in Partyka et al. The examiner has used the disclosure of Applicant's invention as a template to combine the third element with the first two elements in a manner that Partyka et al. do not.

Partyka et al. disclose a method for identifying the location of thin beds in which data windows are formed and frequency spectra within the data windows are formed, and these data windows are utilized to investigate for thin beds. However, Partyka et al. disclose only the identification of troughs in the data for determining the location of thin beds. In no instance do Partyka et al. teach or suggest the identification of frequency peaks in the frequency spectra for the identification of thin beds. The identification of troughs as indicating the presence of thin beds is discussed in the Abstract, and in col. 7, line 17; col. 13, line 11; col. 13, line 43-55; col. 20, line 40; col. 20, line 49; col. 20, lines 60-67; col. 21, line 3-9; col. 20, line 23-29; col. 20, line 42; col. 25, line 15-23; and col. 32, line 53. The portion of the Partyka et al. disclosure cited as disclosing the third element of claim 1 (determining the frequency having the greatest amplitude within the frequency spectrum of the seismic data within said successively selected windows) is in a section of the Partyka et al. patent titled "Alternative Tuning Cube Attribute Displays", in which Partyka et al. discuss a variety of seismic attributes having nothing to do with thin beds. Partyka et al. introduces this section with the statement "It is anticipated by the instant invention that the tuning cube technology disclosed herein might yield additional insights into seismic reflection data beyond the detection and analysis of thin beds discussed previously. (emphasis added) Clearly, the combination of the third element with the first two elements was done because of the disclosure of the present application and not through the disclosure in Partyka et al.

Further, Partyka et al. do not show the fourth element or the fifth element of claim 1. As stated in the present application, there are commercially available visualization software programs that are capable of utilizing the determined frequencies having the greatest amplitude to generate a seismic display in which horizontal dimension represents

distance and vertical dimension represent time. However, it is only because of the disclosure of applicant's invention that one would be led to supply the appropriate data and to direct such a program to generate such a seismic display, and to utilize such a display to determine the presence of thin beds.

Because the claim elements said to be present in Partyka et al. are not disclosed in Partyka et al., Partyka et al. cannot be combined with Cox et al. to render claim 1 obvious.

With respect to Cox et al., it is acknowledged that Cox et al. show a maximum entropy transform, which is a transform having poles on the unit z -circle, where z is the z -transform. It is also acknowledged that Partyka et al. also disclose that other transforms could be utilized to practice the Partyka et al. method other than Fourier transforms. However, there is nothing in either Partyka et al. or Cox et al. that would lead one of ordinary skill in the art to select a transform having poles on the unit z -circle, where z is the z -transform, for use in applicant's invention.

As stated in the present application, use of the maximum entropy transform permits a shorter time window to be utilized. It is an object of the invention to identify just one peak in the frequency spectrum, rather than to precisely estimate the entire spectrum. The transform having poles on the unit z -circle where z is the z -transform is utilized in the present invention because it provides a greater accentuation of peaks in the spectral distribution than a Fourier transform. It is recognized by the inventor that in the present invention the estimate of the frequency away from the peak frequency may be poor.

In contrast, Cox et al. teach that "It is possible to enhance the resolution of a moving-time window analyzer by using a maximum entropy power spectral estimator to approximate the spectrum of each windowed segment of a trace." The objective of Cox et al. is to "approximate the spectrum of each windowed segment". It is the object of the present invention to provide greater accentuation of just one peak in a frequency

spectrum, rather than to approximate the spectrum. There is no suggestion whatsoever in Cox et al. for using the maximum entropy transform or any other transform to provide greater accentuation of a peak in a spectral distribution than a Fourier transform provides.

Claims 13 and 14 are dependent from claim 1 and should be allowable for same reasons as advanced with respect to claim 1.

11-2 With regard to the rejection of claim 2, claim 2 is dependent from claim 1 and claims the embodiment in which the seismic display represents the frequency having the greatest amplitude within each frequency spectrum, and should be allowable for at least the reasons advanced with respect to claim 1. Further, although Partyka discloses that “the seismic attribute “location of maximum frequency” is one of many seismic attributes that could be calculated from the values in a tuning cube, Partyka et al. fail to suggest the use of the locations of maximum frequency for use in generating a display for the location of thin beds.

11-3 With regard to the rejection of claim 3, this claim is depended form claim 2, which is dependent from claim 1, and should be allowable for at least the reasons advanced with respect to claims 1 and 2.

11-4 Claim 4 of the present application includes “generating a substantially horizontal cross-section of said seismic data to represent either the presence or absence of thin beds in said horizontal cross-section”. A significant difference in the element of claim 4 and the Partyka et al. disclosure, is that claim 4 claims the generation of a cross-section, meaning a single cross section, to represent the presence or absence of thin beds. As clearly stated in the cited section of Partyka et al., in the Partyka et al. method “a series of horizontal slices corresponding to different frequencies” are examined for evidence of the thin bed effect.

11-5 With regard to the rejection of Claim 5, Claim 5 is dependent from claim 1 and claims the embodiment of applicant's invention in which the amplitude of the frequency having the greatest amplitudes within each frequency spectrum is determined, and the seismic display represents this amplitude, and should be allowable for at least the reasons advanced above with respect to claim 1. Further, although Partyka et al. disclose determining the amplitude of the frequency having the greatest amplitude within each said frequency spectrum, Partyka et al. fails to suggest any use of the amplitude of the frequency having the greatest amplitude: as a means for identifying the location of thin beds.

11-6 Claim 6 is dependent from claim 5, which is dependent from 1, and should be allowable for at least the reasons advanced with respect to those two claims.

11-7 Claim 7 of the present application includes "generating a substantially horizontal cross-section of said seismic data to represent either the presence or absence of thin beds in said horizontal cross-section". A significant difference in the element of claim 7 and the Partyka et al. disclosure, is that claim 7 claims the generation of a cross-section, meaning a single cross section, to represent the presence or absence of thin beds. As clearly stated in the cited section of Partyka et al., in the Partyka et al. method "a series of horizontal slices corresponding to different frequencies" are examined for evidence of the thin bed effect.

11-8 The scope of claim 15 is similar to the scope of claim 1 and differs only in that it specifies the use of a maximum entropy transform, which is a specific form of a "transform having poles on the unit z-circle, where z is the z-transform". The same arguments expressed above with respect to claim 1 are also applicable to claim 15.

11-9 Claim 16 has been amended for clarity. Claim 16 is dependent from claim 15, and should be allowable for at least the reasons advanced for claim 15.

11-10 Claim 17 is depended from claim 15 and includes specific steps for implementing the invention of claim 15 on a digital computer, and should be allowable for at least the reasons advanced with respect to claim 15.

11-11 The scope of claim 18 is substantially the same as the scope of claim 5 and should be allowable for at least he reasons advanced with respect to claim 5.

11-12 Claim 19 has been amended for clarity. Claim 18 is dependent from claim 18 and should be allowable for at least the reasons advanced for claim 18.

11-13 Claim 20 is dependent from claim 18 and includes specific steps for implementing the invention, and should be allowable for at least the reasons advanced with respect to claim 18.

11-14 Claim 24 is dependent from claim 1 and should be allowable for at least the reasons advanced with respect to claim 1.

11-15 The elements of claim 25 have been included in amended claim 24, and claim 25 has been cancelled.

12 With regard to the rejection of claim 8, claim 8 is dependent from claim 1 and claims the embodiment in which the seismic display represents bed thickness, and should be allowable for at least the reasons advanced with respect to claim 1. Claim 8 is directed to an embodiment of the invention in which the frequency in a frequency spectrum having the greatest amplitude is utilized to calculate bed thickness, but only if the peakedness of the frequency spectrum exceeds a selected value of peakedness. Partyka et al. neither disclose nor suggest utilizing the frequency having the greatest amplitude within a frequency spectrum to identify the location of thin beds or to calculate the bed thickness. The reference in the present application on lines 20-23, page 13 to a standard formula known to those of ordinary skill in the art, is referring to a formula for calculating peakedness. The reference to using thickness in col. 6, lines 24-28 of Partyka

et al. refers to a step in a calibration process to establish a “tuning” amplitude for the thin bed event in question. It is said further in col. 6, lines 37-40 of Partyka et al., however, “Further, the calibration based method disclosed above is not well suited for examining thin bed responses over a large 3-D survey”. Isolated phrases have been taken out of context and have been pieced together to make a statement that is not made by the documents from which the phrases were taken. There is no suggestion in Partyka et al. of utilizing the frequency having the greatest amplitude within a frequency spectrum to generate a display representing bed thickness. It is acknowledged that visualization software packages exist that can generate such a display if appropriate data are supplied to the program and instructions are provided to the program to generate the display. However, such programs do not intrinsically generate such displays without applying appropriate data and instructions, and nothing in Partyka et al. suggests providing such data or such instruction to such a program.

Claim 9 claims the embodiment of the invention in which peakedness is kurtosis. Claim 9 is dependent from claim 8 and should be allowable for at least the reasons advanced with respect to claim 8. Claim 10 is dependent from claim 1, and is of substantially the same scope as claim 9, and should be allowable for the same reasons advanced above with respect to claims 1, 8 and 9.

Claim 11 is dependent from claim 10 and should be allowable for substantially the same reasons stated above.

Claim 12 is dependent from claim 11 and should be allowable for the reasons advanced above from which claim 12 depends. Further it is not seen that column 7, lines 10-13 make any reference to “generating a substantially vertical cross-section of said seismic data”.

The relevance of Kern et al. is merely that of showing the use of kurtosis in an unrelated field. Because neither Partyka et al. taken alone or Partyka et al. combined with Cox et al., disclose or suggest the elements of the claims upon which claim 8-12 are

dependent, the addition of Kern et al. is insufficient to render any of these claims obvious.

12-4 Claim 21 claims a specific embodiment of the invention in which kurtosis is calculated for each frequency spectrum, a determination is made if each frequency spectrum exceeds a selected value of kurtosis, and the frequency components having the greatest amplitude within each frequency spectrum which exceeds the selected value of kurtosis is used to calculate bed thickness. Claim 21 is a specific implementation of the embodiment of claim 1 and the rejection of claim 21 is traversed for the same reasons advanced above with respect to claim 1. As stated above with respect to claim 1, in the Office Action the first two elements of the claim have been combined with the third element in a manner neither taught nor suggested in Partyka et al. The examiner has used the disclosure of Applicant's invention as a template to combine the third element with the first two elements in a manner that Partyka et al. do not. Further, neither Partyka et al. nor Cox et al. either alone or in combination disclose or suggest utilizing determined frequencies having the greatest amplitude to generate a seismic display in which horizontal dimension represents distance and vertical dimension represents time, and utilizing the seismic display to determine the presence of thin beds. As stated with above in the discussion regarding claim 1, there are commercially available visualization software programs that are capable of utilizing the determined frequencies having the greatest amplitude to generate a seismic display in which horizontal dimension represents distance and vertical dimension represent time. However, it is only because of the disclosure of applicant's invention that one would be led to supply the appropriate data and to direct such a program to generate such a seismic display, and to utilize such a display to determine the presence of thin beds.

The relevance of Kern et al. is merely that of showing the use of kurtosis in an unrelated field. Because neither Partyka et al. taken alone or Partyka et al. combined with Cox et al., disclose or suggest the other elements of claim 21, the combination of Kern et al. with the other cited references is insufficient to render claim 21 obvious.

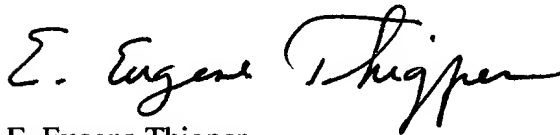
12-5 Claim 22 has been amended for clarity. Claim 22 is dependent from claim 21 and should be allowable for the reasons advanced above with respect to claim 21.

12-6 Claim 23 includes steps for implementing the invention of claim 21 on a computer and should be allowable for at least the reasons advanced above with respect to claim 21.

It is believed that the application is now in condition for allowance. Should there be any residual issues an office interview is respectfully requested, to be attended by applicant's attorney and a technical representative from Apache Corporation, the assignee of the application.

In view of the foregoing amendments and remarks, reconsideration and allowance of the pending claims is respectfully requested. Each ground of rejection in the Office Action is discussed herein and is respectfully traversed. The invention as defined in the claims is neither anticipated nor obvious in view of the cited referenced, either alone or in combination. A Notice of Allowance is respectfully requested.

Respectfully submitted,

A handwritten signature in black ink, reading "E. Eugene Thigpen". The signature is fluid and cursive, with the first name "Eugene" and last name "Thigpen" clearly legible.

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